Environment Canada Environnement Canada

Canada

Canadian Contribution to GPM Science

Paul Joe, Dave Hudak, Peter Rodriguez and Stella Melo

Cloud Physics and Severe Weather Research Section,
Environment Canada

Outline

- Objectives
- The Activities
  - King Radar – Tier 1 Validation Site
  - Olympex
  - PIP
  - Arctic Supersites

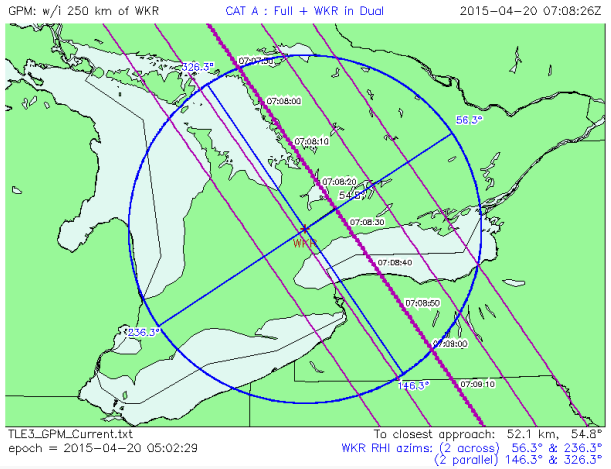
Objectives

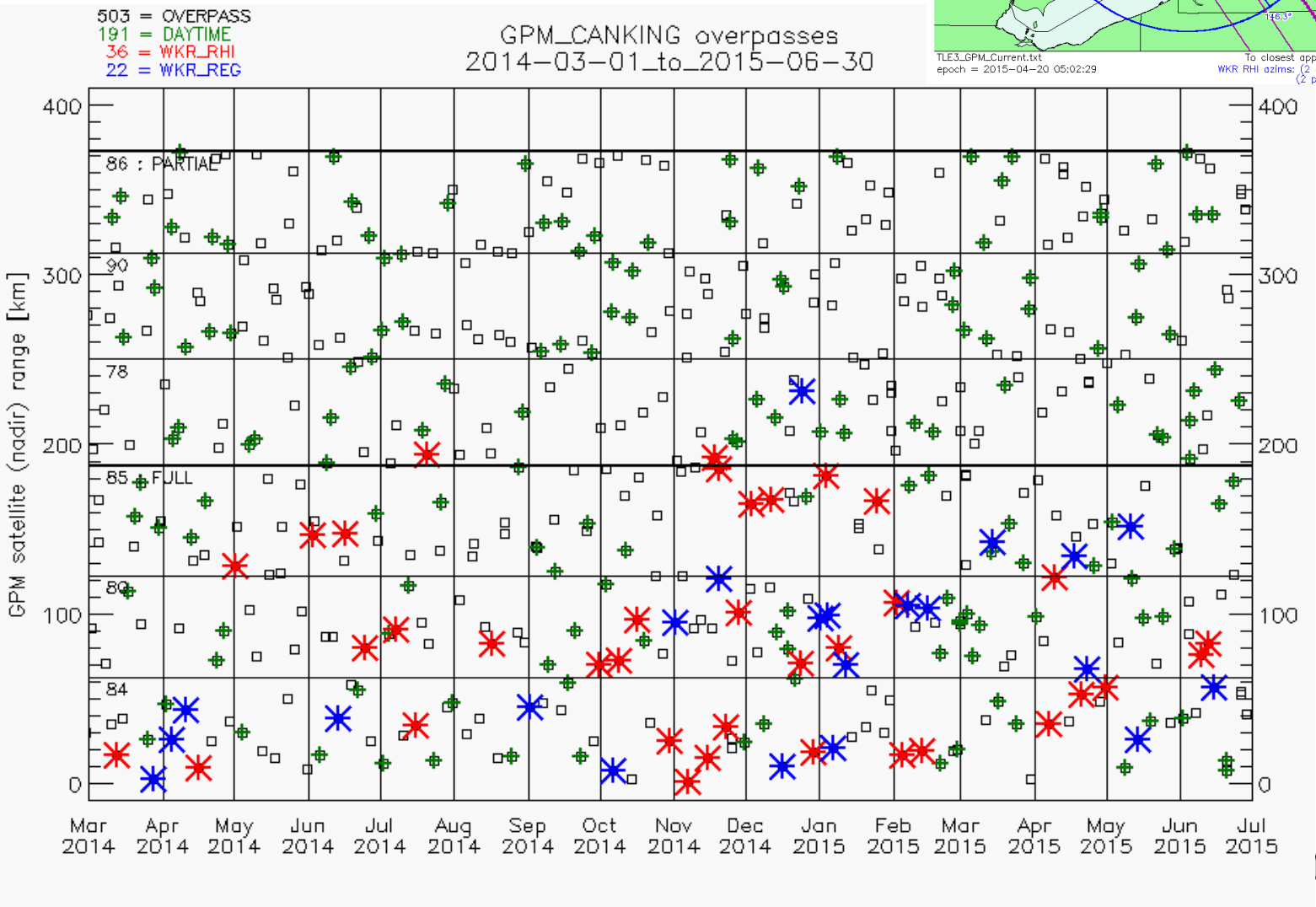
- Snow/Light Precipitation (Arctic)
- Arctic Applications :
  - MetNav, Prediction, Aviation Nowcasting, Climate
- Integrated Observation Systems
  - Arctic focus
- Statistical/Physical Validation/verification of GPM products
  - Ongoing since March, 2014
- Relate to earlier physical validation/studies
  - the GPM Cold Season Precipitation Experiment 2011/12 (GCPEx) in the Great Lakes area of central Canada led by Environment Canada (EC) and NASA and also supported by Canadian, US and European university groups

KING CITY – TIER 1 VALIDATION

WKR Tier-1 Ground Validation effort

- GPM overpass predictions for proximity and possible wx
- 4 manual RHIs {cross-, along-track, echo cell aims}
- Operational volume scans available every 10-minutes

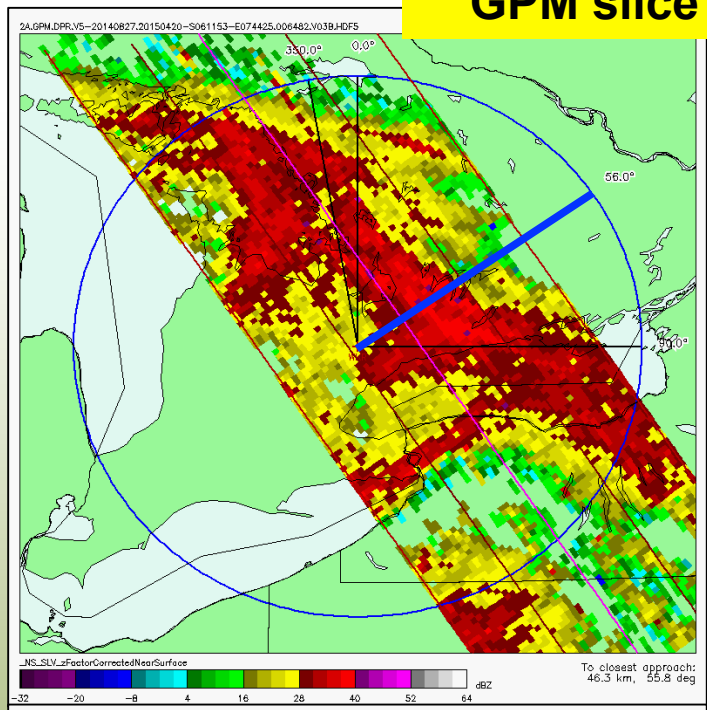


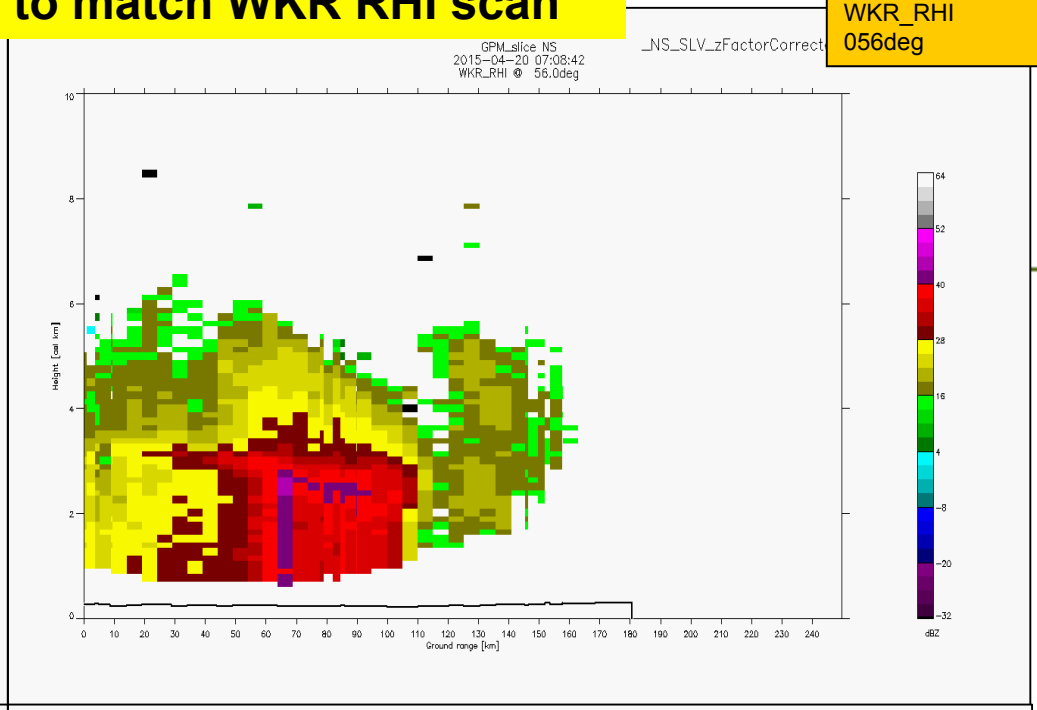


GPM slice to match WKR RHI scan

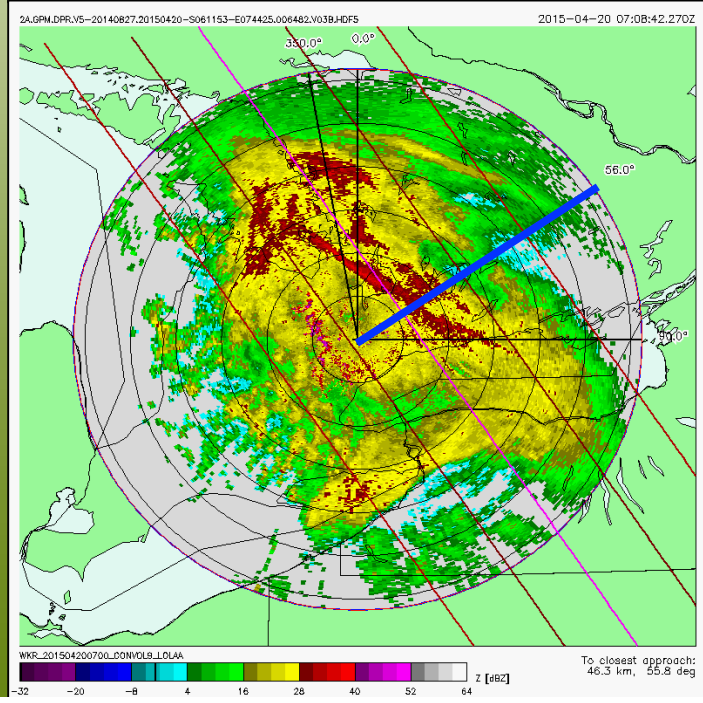
2015-Apr-20 0708Z
WKR_RHI
056deg

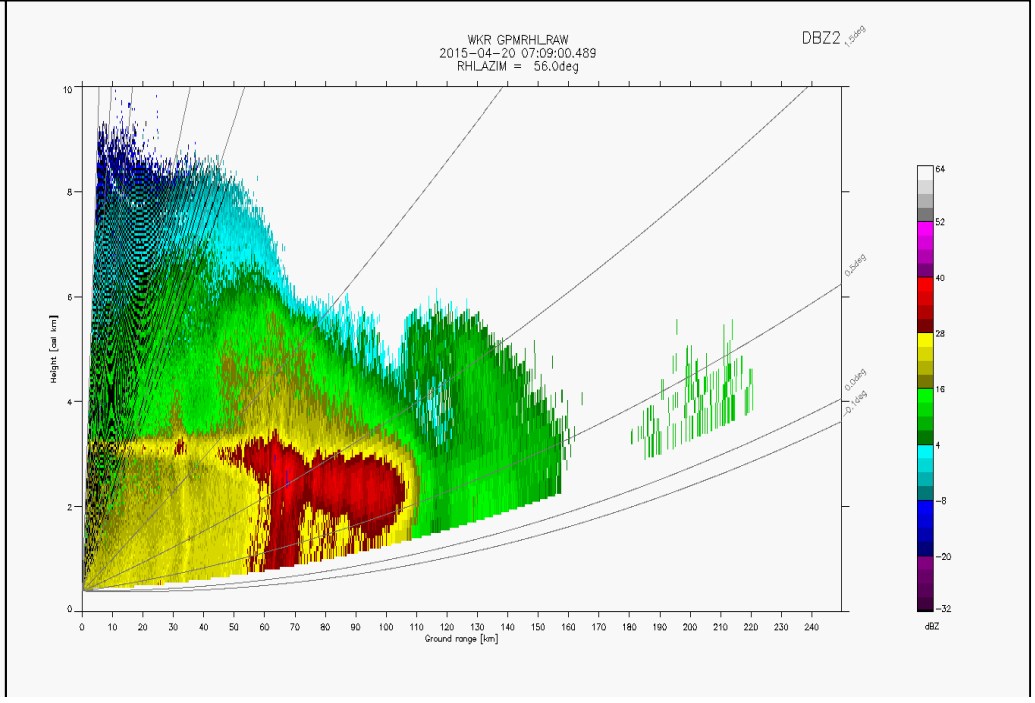
GPM
DPR (NS)





WKR

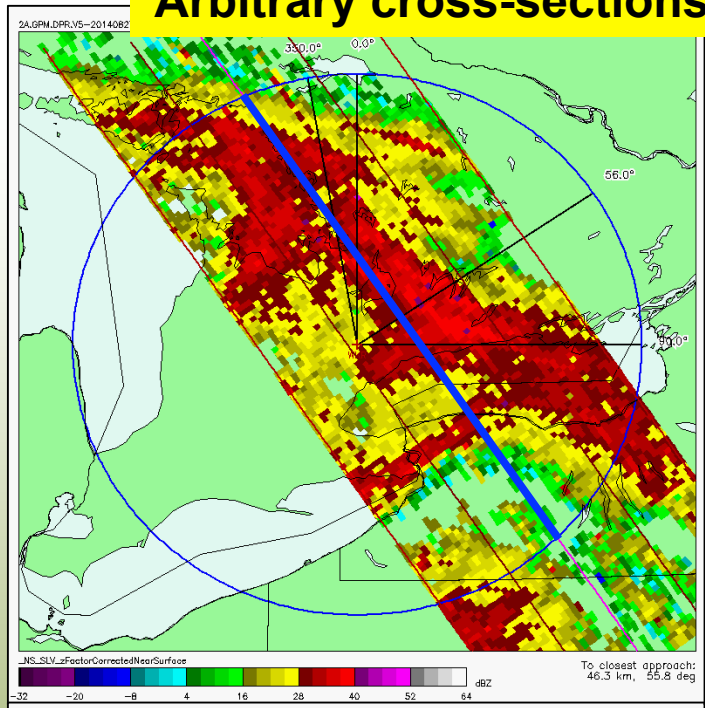


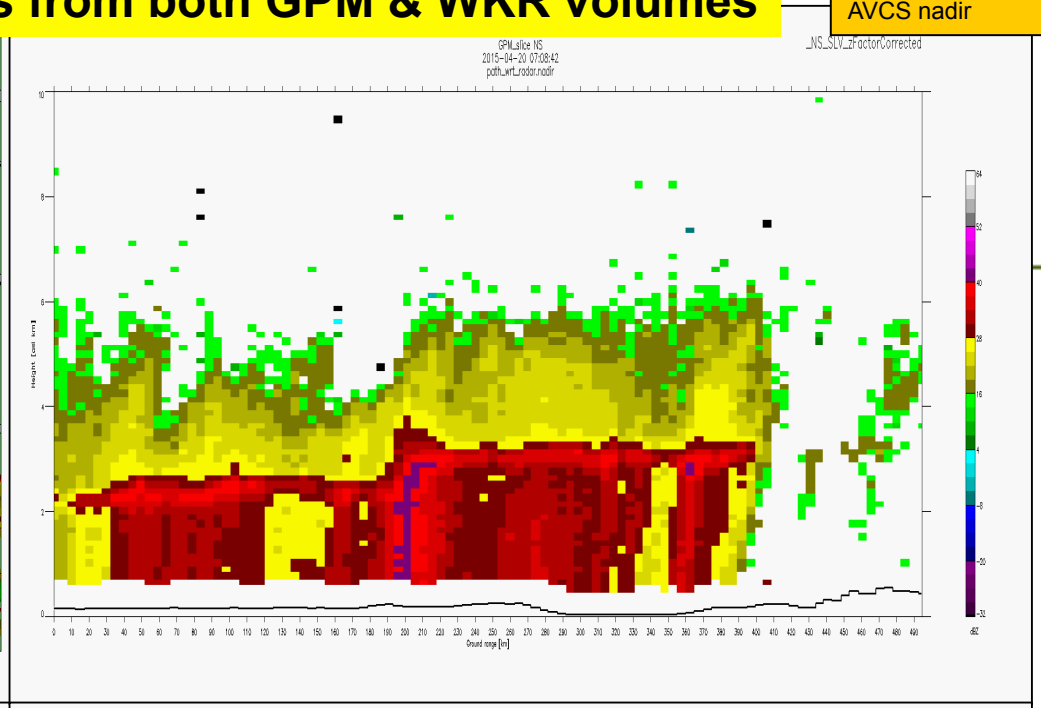


Arbitrary cross-sections from both GPM & WKR volumes

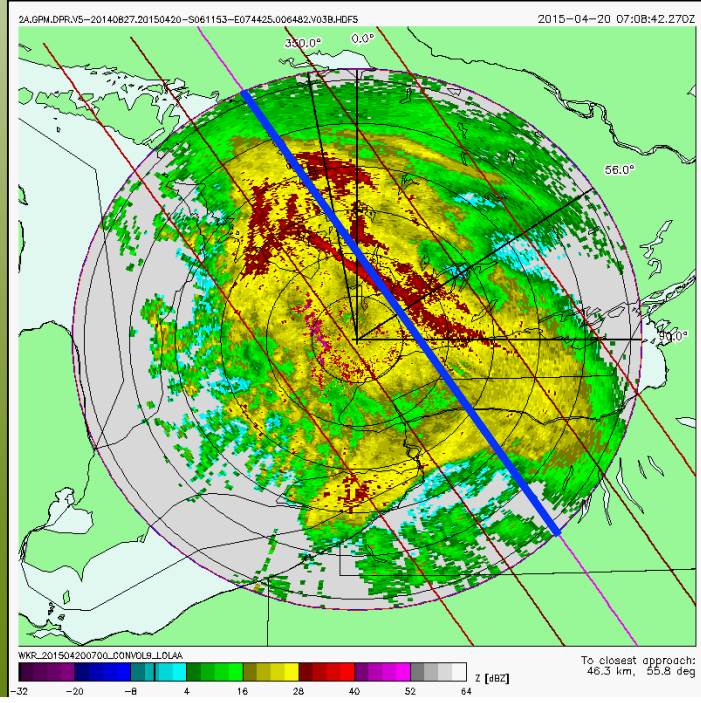
2015-Apr-20 0708Z
AVCS nadir

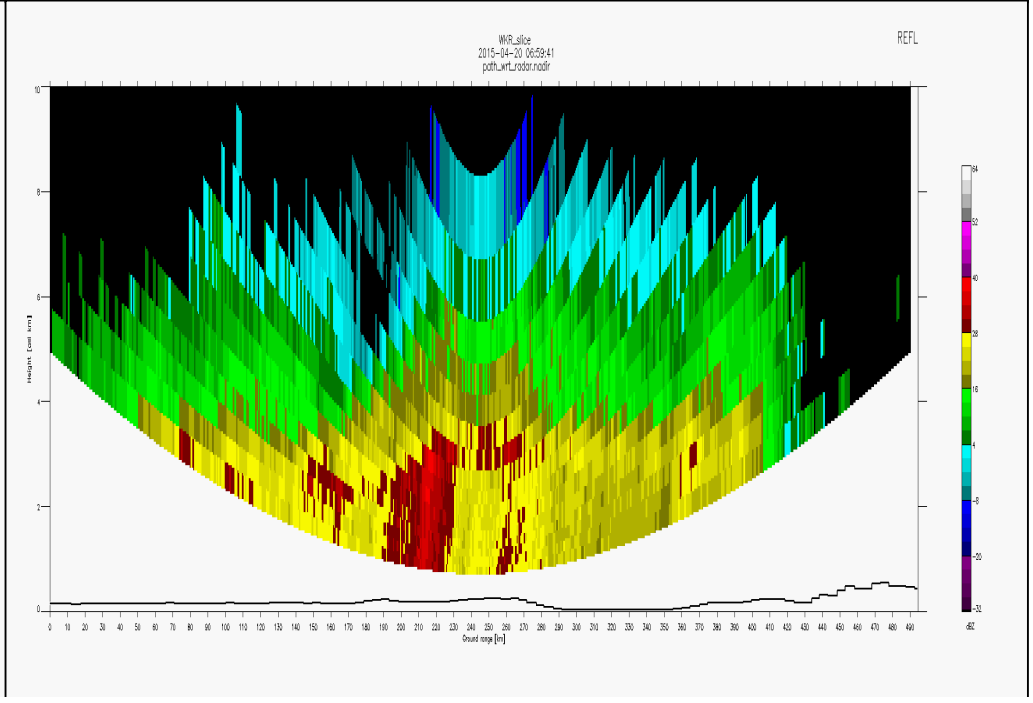
GPM
DPR (NS)





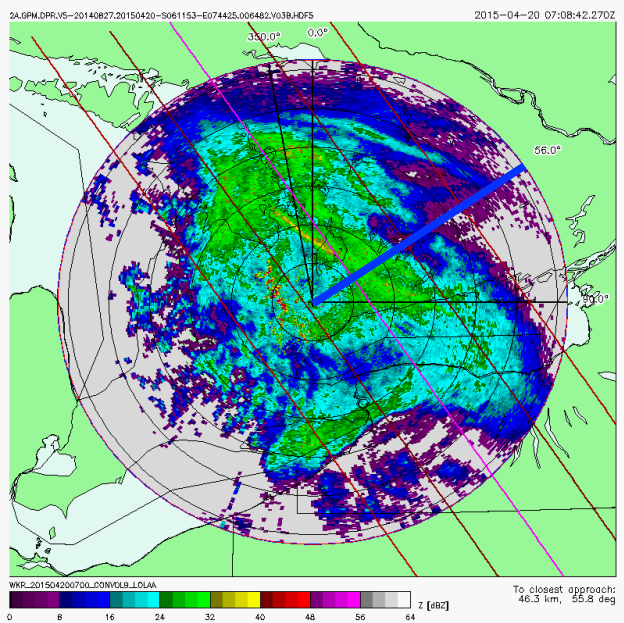
WKR

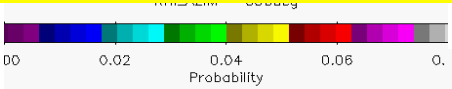


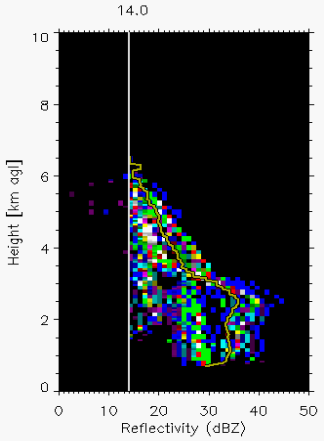


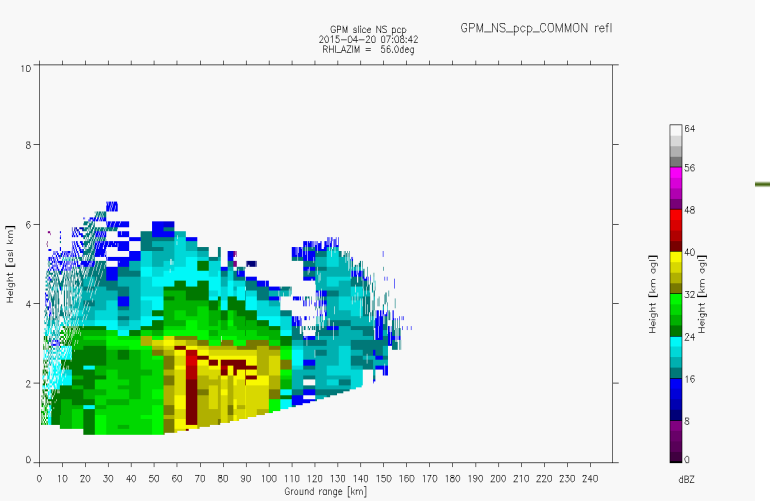
DBZ distribution comparison

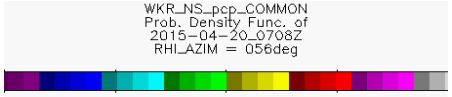
2015-Apr-20 0708Z
WKR_RHI
056deg

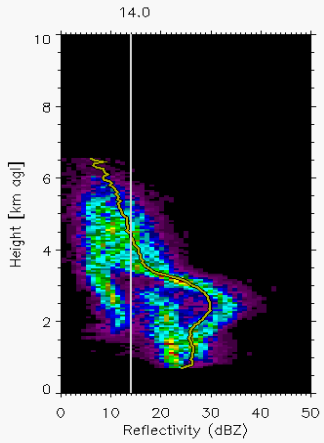


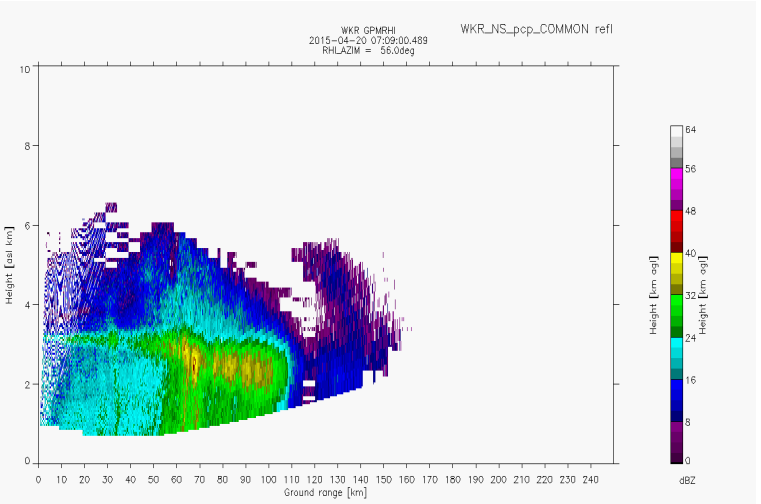


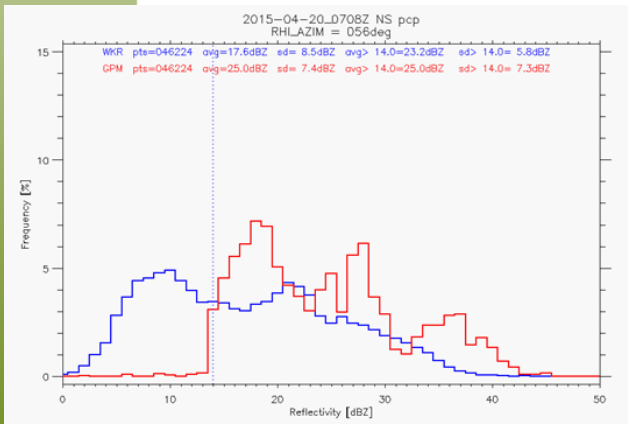










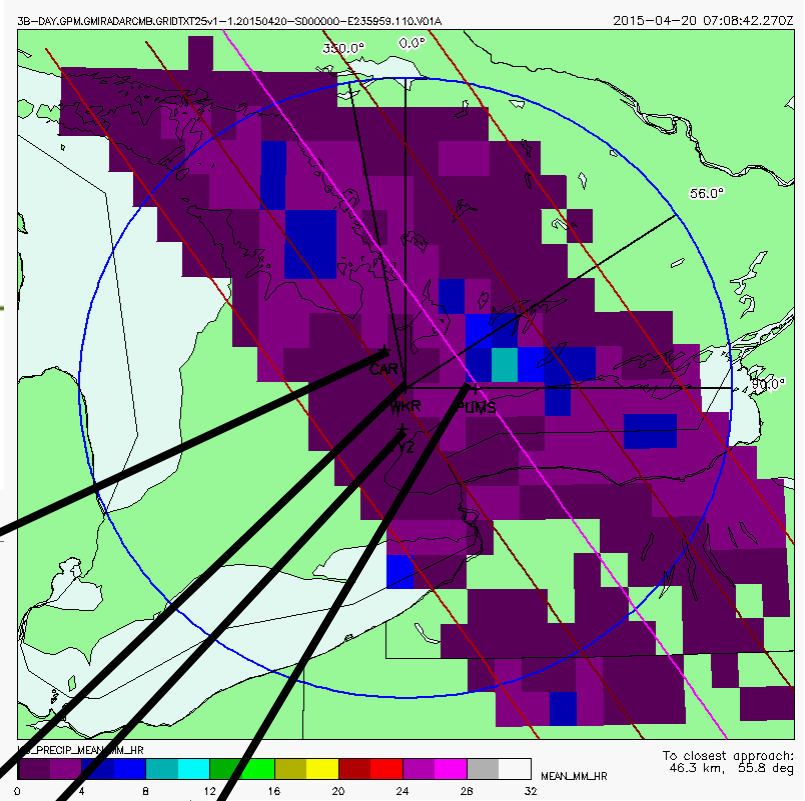


Environment Canada Environnement Canada

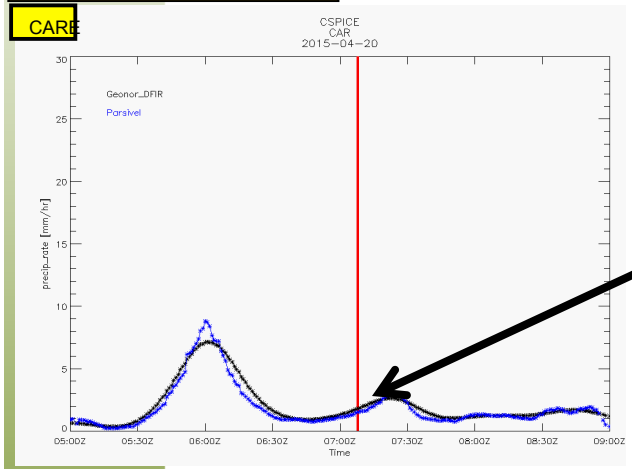
Same as previous RHI but color scheme is different

GPM-3B (¼deg grid) precip rate compared to ground measurements

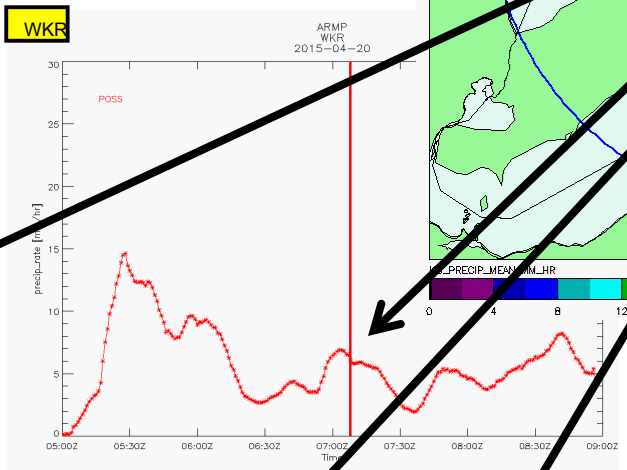
2015-Apr-20 0708Z



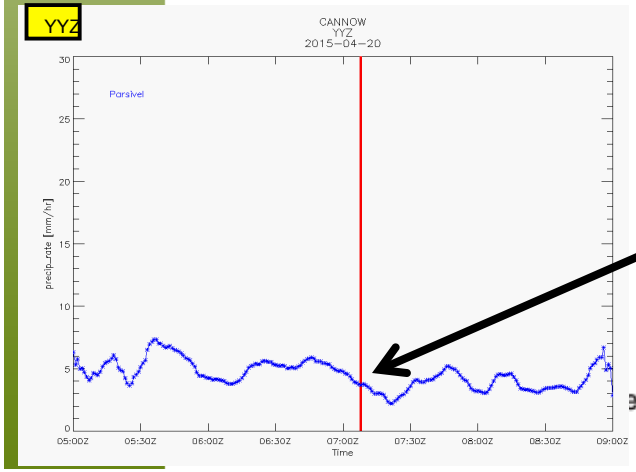
CARE



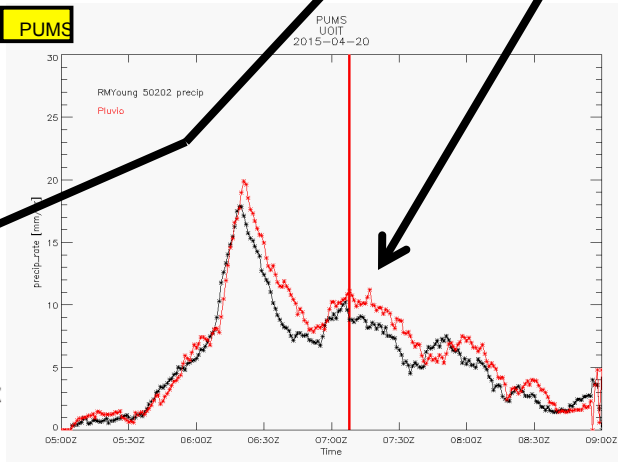
WKR



YYZ

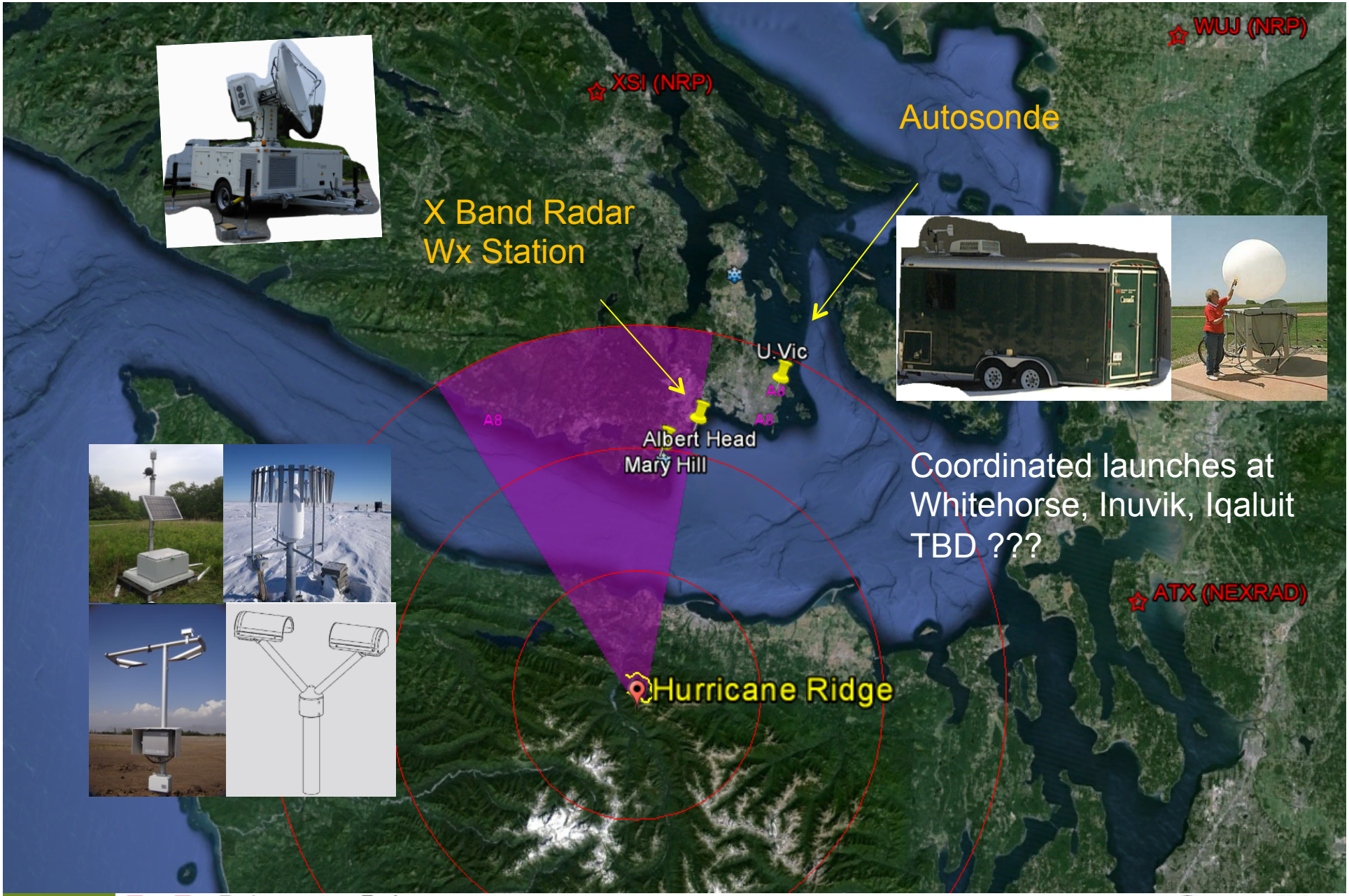


PUMS

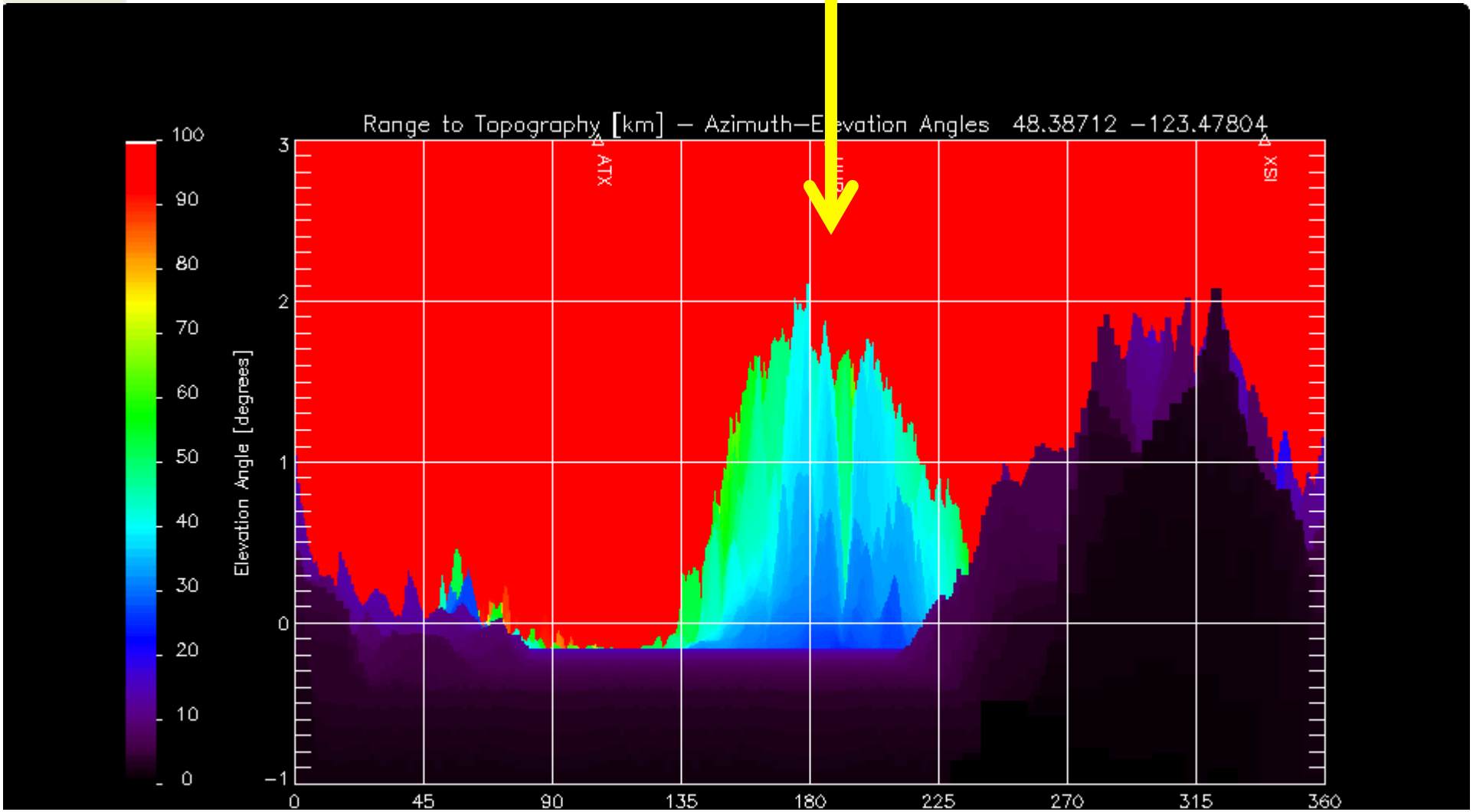


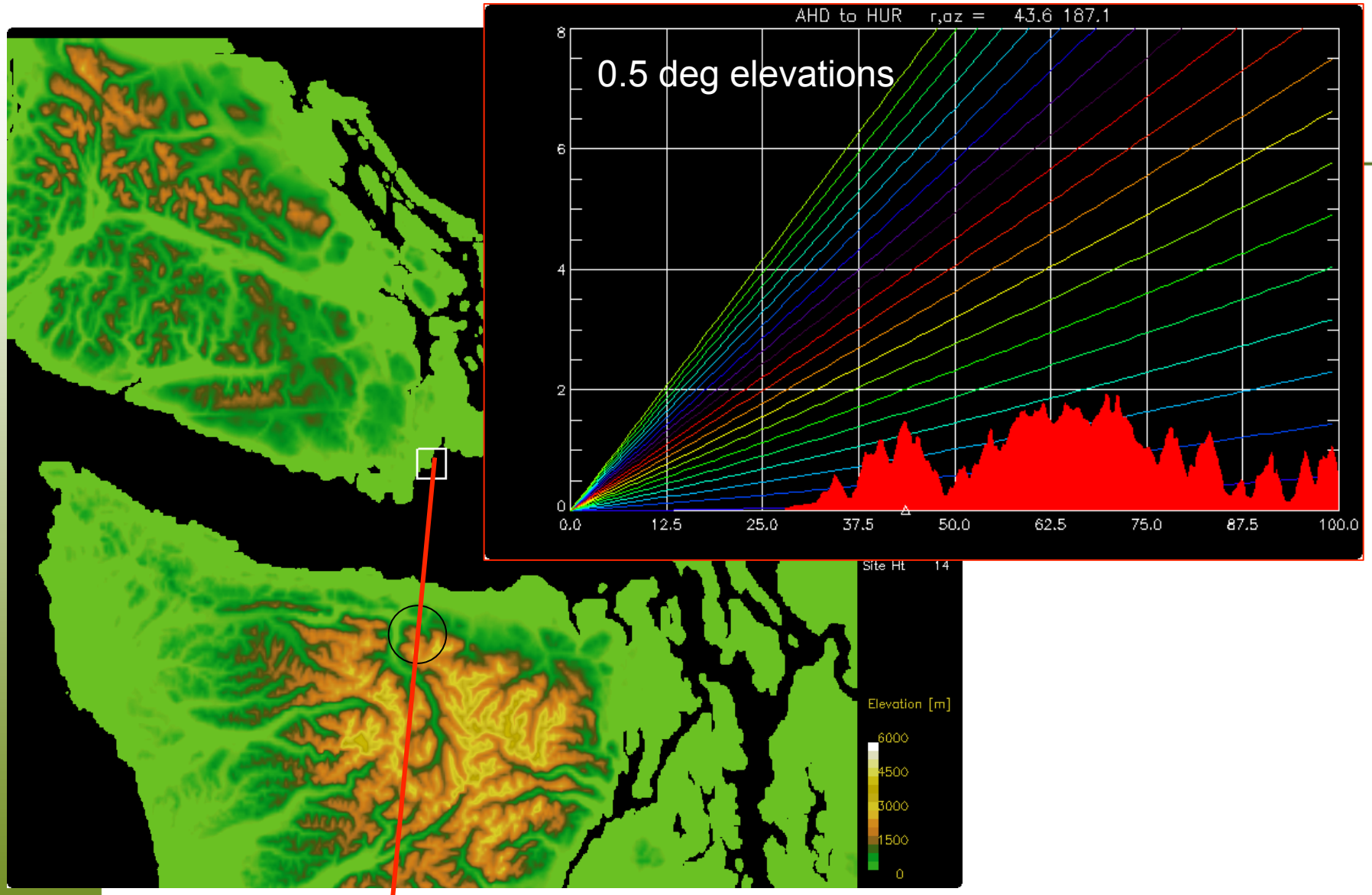
Canada

OLYMPEX


WUJ (NRP)
XSI (NRP)
Autosonde
X Band Radar
Wx Station
U.Vic
A8
A8
A8
Albert Head
Mary Hill
Coordinated launches at
Whitehorse, Inuvik, Iqaluit
TBD ???
ATX (NEXRAD)
Hurricane Ridge

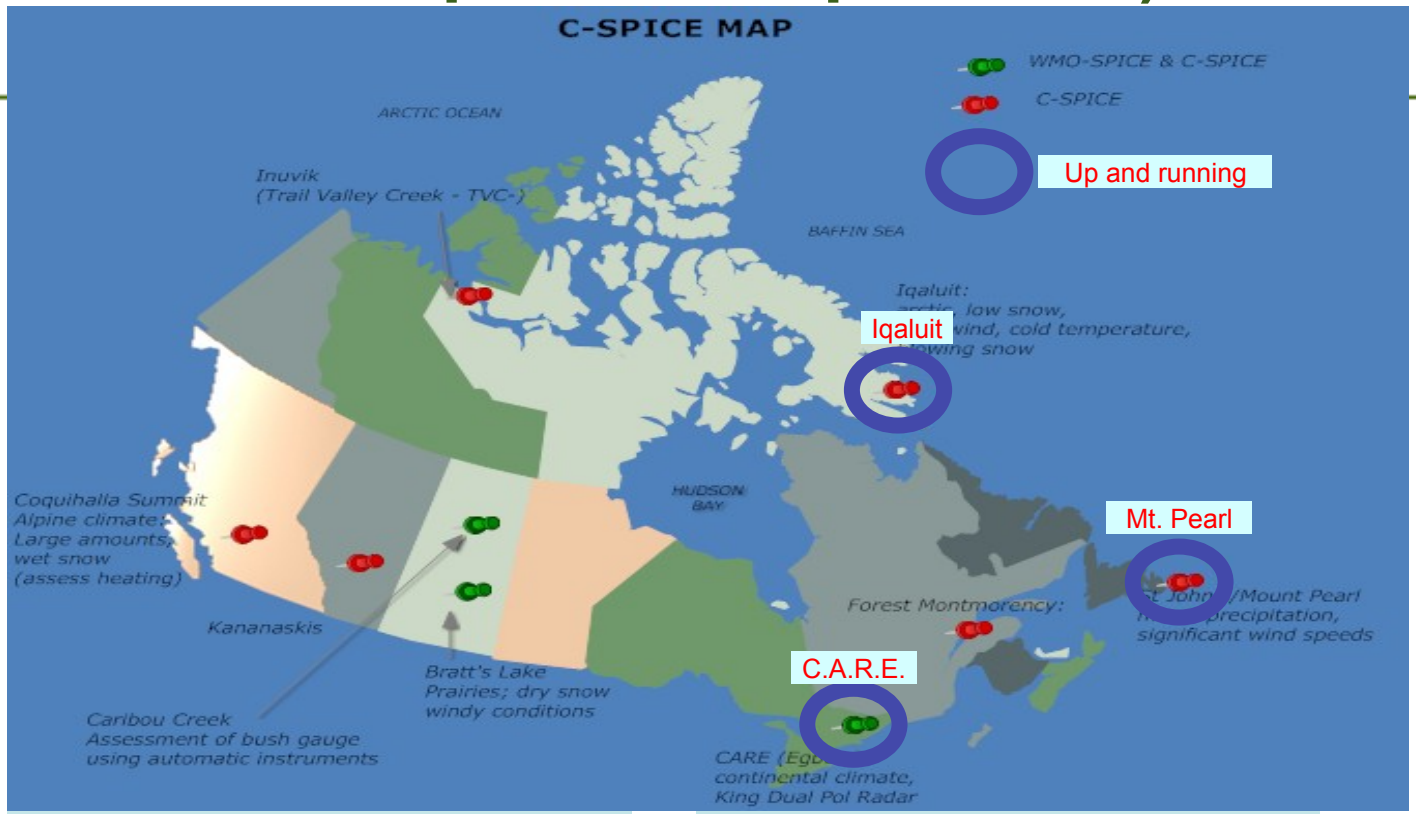
Range [km] to Topography
(Elevation Angle and Azimuth)




AHD to HUR r,az = 43.6 187.1
0.5 deg elevations
8
6
4
2
0
0.0
12.5
25.0
37.5
50.0
62.5
75.0
87.5
100.0
Site Ht 14
Elevation [m]
6000
4500
3000
1500
0

PRECIPITATION IMAGING PACKAGE (PIP)

PIP and C-SPICE
(Canadian Solid Precipitation Experiment)



Jun-2014: CARE,

Sep-2014: Iqaluit, NU

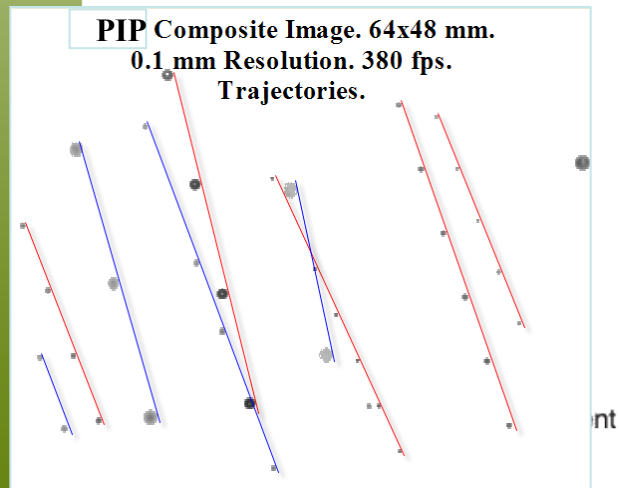
Sep-2014: Mt. Pearl, NF

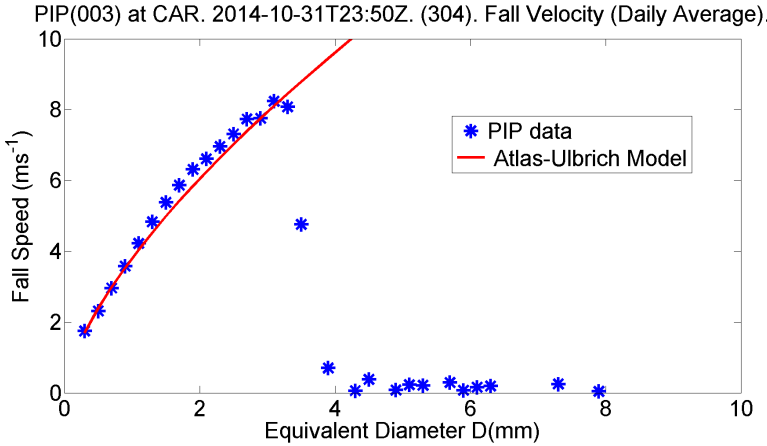
Environment Canada

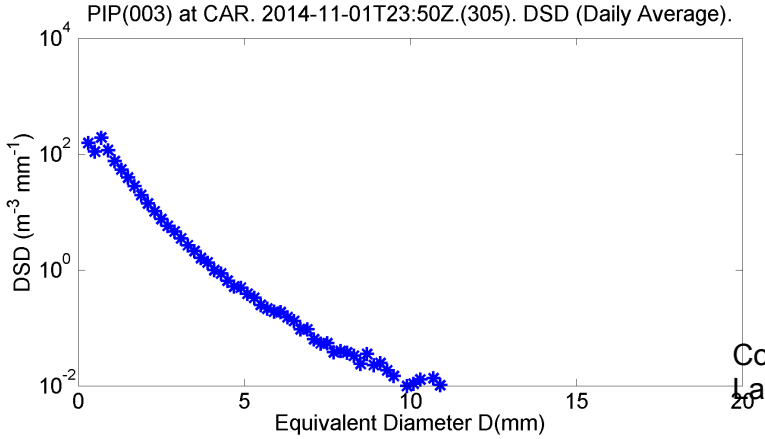
PIP = NextGen PVI (Precip Video Imager)

Camera	Basler PiA640-210gm
Cabling	**100ft GigE**
Video	**Digital**
Frame rate	**380 fps**
Pixels	640 x 480
Sample area	64 x 48 mm
Resolution	0.1 x 0.1 mm
Processing	**fall speed & DSD analysis**

Fall-speed from high frame rate particle tracking.
Non-rain discrimination if >15% from V(D) model
Daily and hourly DSD and fall-speed plots
Research: volume-weighted eDensity

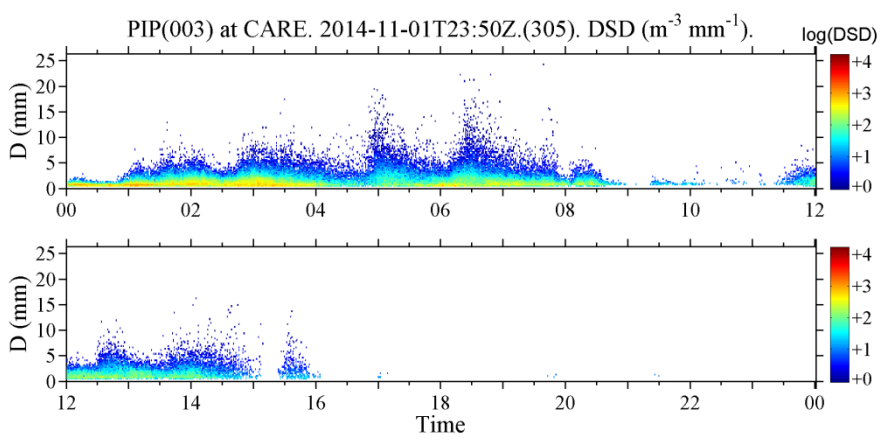


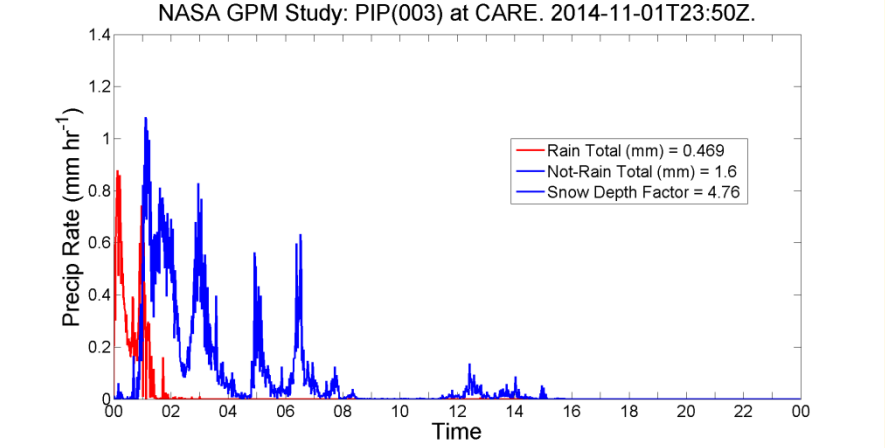


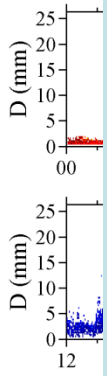


Courtesy of NASA Larry Bliven

PIP at CARE. 2014/11/01.







Early rain, then CARE's 1st snow event this winter.

CARE precip gauges:

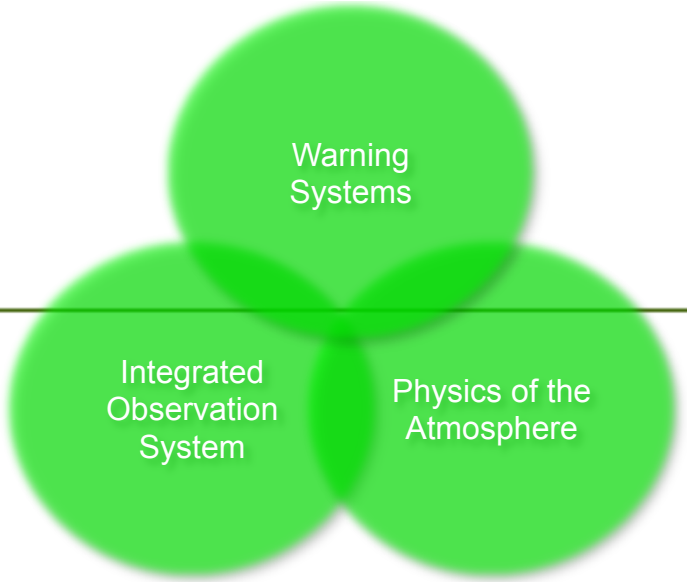
- 1.82mm = H2 = "WG Geonor T200B3-600mm 6 Sec", "DFIR,Single Alter Shield,CRN Heating,Installed at 3M."
- 1.49mm = H4 = "WG Geonor T200B3-600mm 6 Sec", "Base 3B, Belfort Double Alter, OSE Heating"
- 1.77mm = H5 = "WG Geonor T200B3-1500mm 6 Sec", "Base 8, Belfort Double Alter, OSC Heating"
- 1.60mm = HN = "WG OTT Pluvio2 200cm2 6 Sec", "Base 4A, Belfort Double Alter, Heated"
- 1.61mm = HO = "WG OTT Pluvio2 200cm2 6 Sec", "Base 7, Belfort Double Alter, Heated"

PIP:

- 0.47mm = Rain
- 1.55mm = Not-Rain

ARCTIC PROJECTS (IQALUIT)

Projects



1. Enhancing Services for the North: Ground-based Meteorological Stations
2. Solid Precipitation Inter-comparison Experiment
3. Arctic Observing System (MSC Renewal)
4. ADM-Aeolus (Wind)
5. Global Precipitation Mission

} Integrated Observing Systems

6. EarthCARE
7. CloudSat

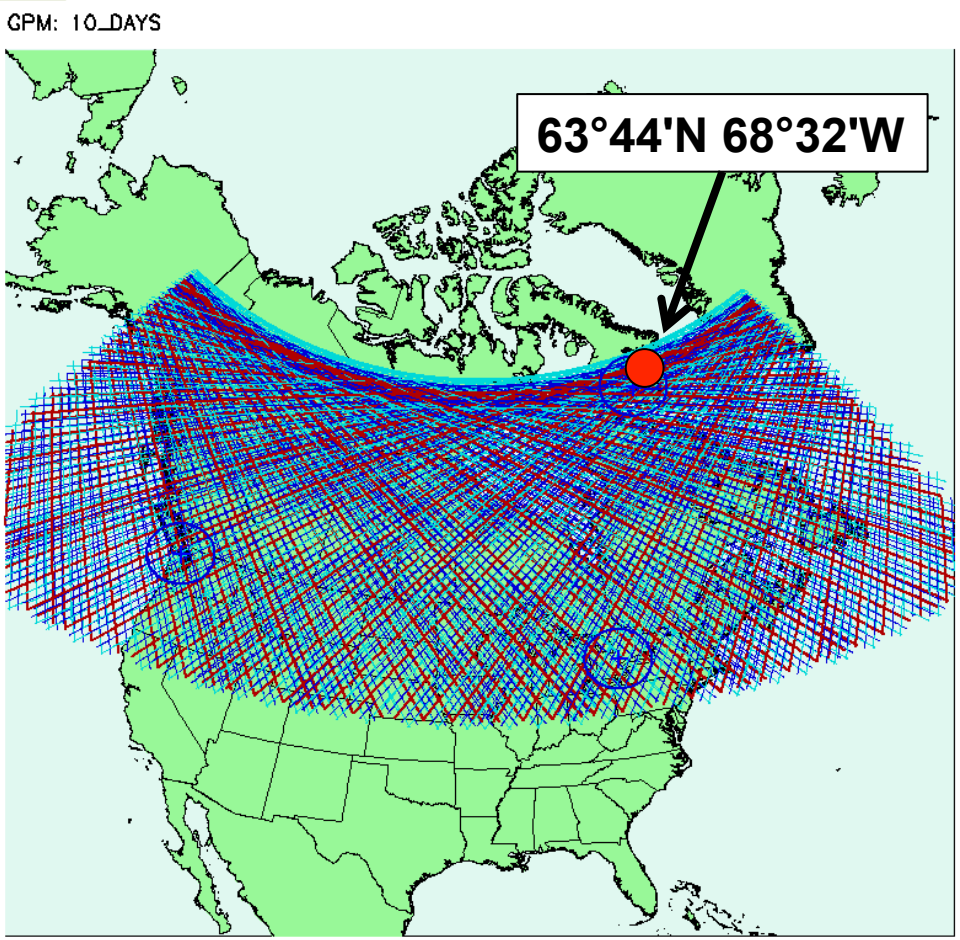
} Climate Change Science

8. Aviation Nowcasting for the North
9. Polar Prediction Project/YOPP
10. METNAV II, etc (TBD)

} Warning/Prediction

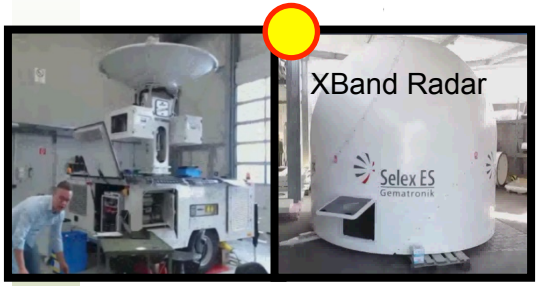
Environment Canada Environnement Canada

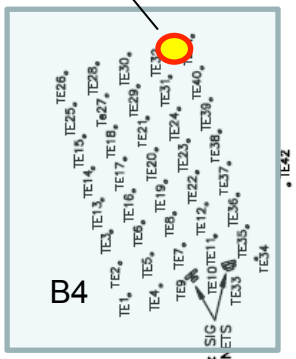
CSPICE and Arctic Infrastructure Project (Iqaluit Supersite Plans)



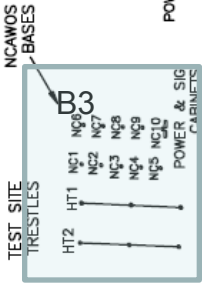
Arctic Infrastructure

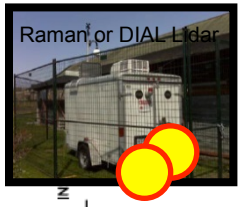
uit Instrument
n 2015/16
rument
ic Met
ometer - CL25K
ometer - CL31L
Plate
AR - Doppler
Ozone/ radiosonde launch
Parsivel DSD
PIP
POSS
Precip Gauges
PWS100
Radar - Ka Band
Radiometer (MP-3000A)
Rosemount Icing Probe
Multi-Angle Snow Cameria
Theis DSD
Transmissometer
Viz Sensor PWD22
Viz Sensor PWD52

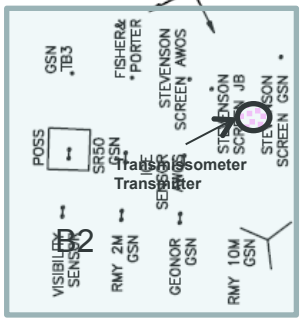


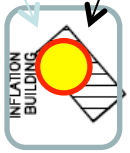


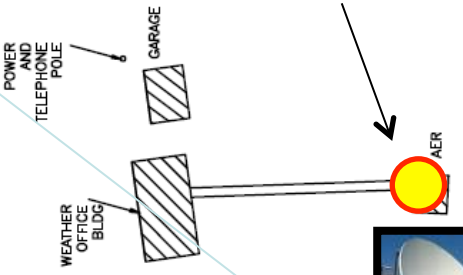
Off-site
NC T121?

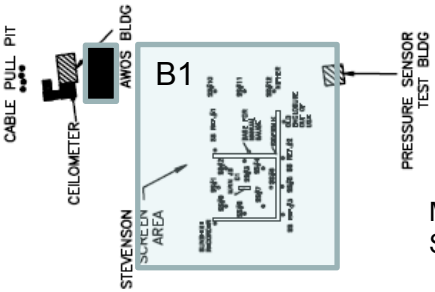


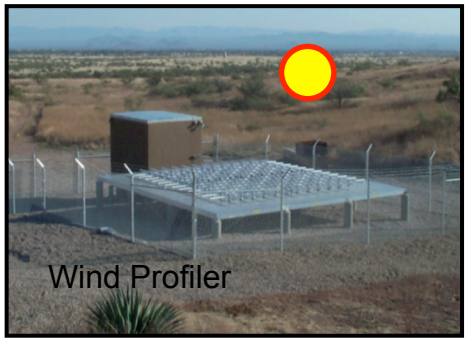












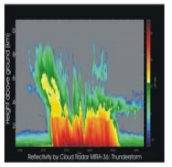
Multi Angle
Snow Camera

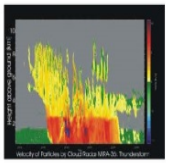
Sat D

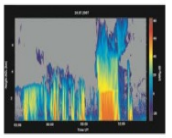
Cloud Radar MIRA-35

Typical Applications

- Research in meteorology
- Wake vortex monitoring
- Icing hazard detection
- Cloud particle characterization
- Eddy correlation fluxes
- Wind shear detection
- Synergy with other remote sensing instruments
- Fog detection and nowcasting
- Meteorological networks
- Research stations
- Industrial sites
- Airports
- Marine and offshore platforms
- Wind energy
- input for weather prediction
- Sport events







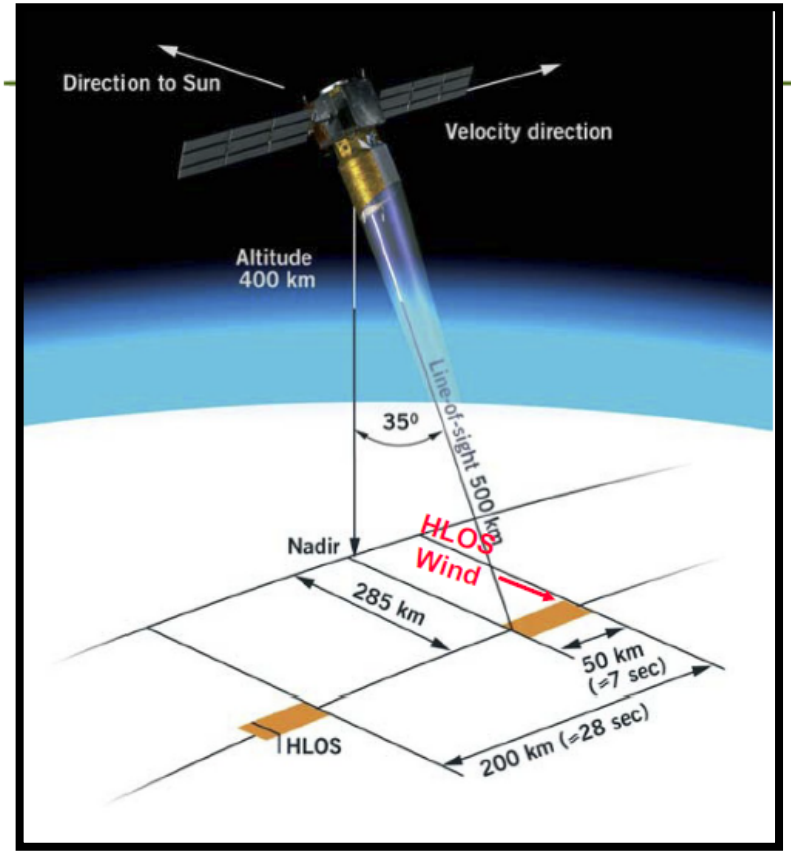
MIRA-35 is a Ka-Band Doppler radar with high sensitivity allowing to observe even light clouds. It is designed for unattended long-term operation. MIRA-35-S is mounted on a pedestal allowing elevation and azimuth scanning within zenith angles from -90 to +90° and azimuth angles from 0 to 360° (continuous rotations).

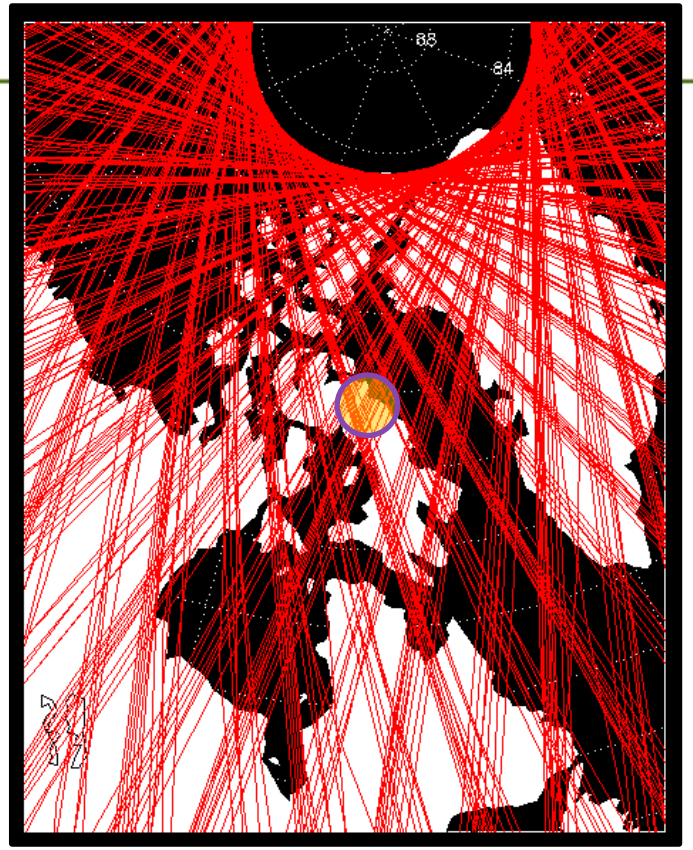
Transmit Frequency	33 – 37 GHz, 35.2 GHz recommended by ECC
Peak Power / Average Power	30 kW / 30 – 60 W
Sensitivity	- 53 dBZ (5 km range, 30 m range resolution and 10s time resolution, 1m antenna)
Max. Measuring Range	Depending on pulse width and PRF up to 60 km
Min. Measuring Range	150 m full sensitivity above 450 m
Max. Number of Gates	1000
Min. Time Resolution	0.1 s
Beam Width	0.5° with 1 m and 0.3 with 2 m antenna
Antenna Diameter	1 m, 1.2 m, or 2 m
Pulse Width	100 – 400 ns
Pulse Repetition Frequency	2.5 to 10 kHz
Velocity Resolution	5 cm/s
Polarization Parameters	Linear polarization on transmit, co and cross polarized signals are received simultaneously . LDR, and co-cross-correlation can be computed. Alternatively STAR mode can be provided.
Dimensions of the radar electronics	Transmitter 19" Chassis 9 U, Receiver 4 U, PC 4 U (depth of all units 530 mm).
Power consumption depending on the duty cycle	Radar: 950 W at 1/500 600 W at 1/1000 PC+DSP 150 W Air Conditioning 800 W for the vertically viewing and 1.6 kW for the scanning system.

METEK GmbH, Fritz-Strassmann-Str. 4, 25337 Elmshorn, Germany
Phone: +49 4121 43590, Fax: +49 4121 4359 20
E-mail: info@metek.de, Internet: http://www.metek.de

ADM-AEOLUS

OPERATIONAL WIND PROFILING FROM SPACE
CAL/VAL FROM YFB, 2017





Summary

- GPM studies
  - EC King City Radar a Tier I GPM validation site
  - OLYMPEX participation (winter 2015/16 over Olympic Peninsula, Washington)
  - Arctic Super Site
- Challenges in cold season for validation/verification
  - Complex microphysics (snow and mixed phase)
  - Vertical evolution in lowest levels can bias near surface GPM products in snow
  - Weather regime dependency on data quality/representativeness
  - Light Precipitation
- Validation
  - Arctic focus (Iqaluit)
  - Whitehorse
  - Inuvik
  - CARE
  - Pearson Airport
  - PUMS